PATENT ABSTRACTS OF JAPAN

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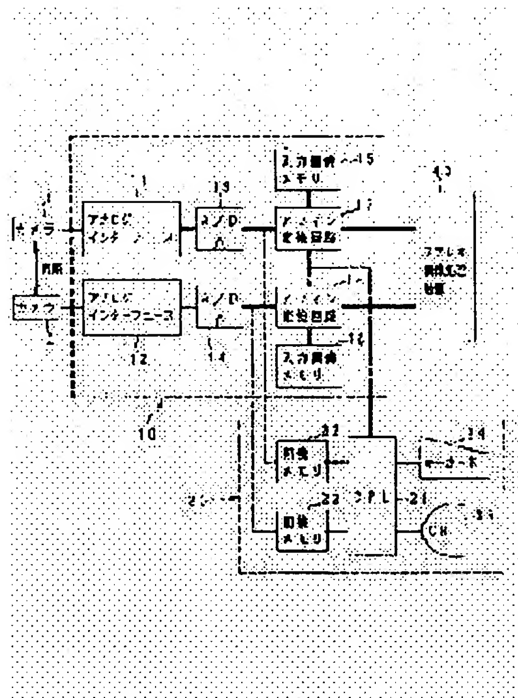
(54) ADJUSTMENT DEVICE FOR STEREOSCOPIC CAMERA



(57)Abstract:

PROBLEM TO BE SOLVED: To accurately adjust the optical position of a stereoscopic camera to such a level that it is difficult to be mechanically adjusted and to easily adjust it again even when it is deviated by secular change after it is adjusted once.

SOLUTION: When the optical positions of the CCD cameras 1 and 2 are initially adjusted or they are deviated from the positions of the initial adjustment time by the secular change, a correction value detection device 30 is connected to an image correction device 10 and the transformation value of affine transformation corresponding to the difference between the viewing angles, the rotating deviation and the translational deviation of images picked up by the cameras 1 and 2 is calculated so as to set the correction device 10. Then, the images picked up by the cameras 1 and 2 are affine-transformed by the correction device 10 and outputted to a stereoscopic image processor 40 by equivalently accurately adjusting the optical positions of the cameras 1 and 2.

LEGAL STATUS

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the adjusting device of the stereoscopic camera which adjusts the optical location of a stereoscopic camera electrically, without performing mechanical adjustment.
[0002]
[Description of the Prior Art] The image processing by the so-called stereo method which searches for correlation of one pair of images which picturized the object from a different location, and generally finds distance by the principle of triangulation as three-dimensions measurement technology by the image using camera parameters, such as an installation location of a stereoscopic camera and a focal distance, from the parallax over the same body with two cameras (stereoscopic camera) is known.
[0003] In the image processing by this stereo method, since he is trying to ask for the location whose two picture signals piled up carrying out the sequential shift of the two picture signals acquired from the stereoscopic camera, and corresponded, it is desirable for there to be no gaps other than parallax between two images, and it becomes important [optical positioning of a stereoscopic camera]. For this reason, the optical-axis controller material adjusted so that the optical axis of one [an parallel adjustment means and] video camera and the optical axis of the video camera of another side which are adjusted to the attachment component which carries out connection maintenance of the video camera of a pair so that it may become the list and parallel whose list of the pixel of the image sensors of one video camera is the pixel of the image sensors of the video camera of another side may become parallel is prepared in JP,5-1157557,A, and the technology of adjusting and holding the correlation of two cameras mechanically is indicated.
[0004]
[Problem(s) to be Solved by the Invention] However, in a stereoscopic camera, six mechanical location gap elements exist, in one pair of images with which adjustment of the optical location of a stereoscopic camera was picturized as it is imperfect, it becomes three gaps and appears, and the variation in the focal distance of each lens serves as a difference of a field angle, and it appears.
[0005] As shown in drawing 10 (a), namely, the cameras 50a and 50b on either side (L, R) If the direction of an optical axis of a camera is based on right camera 50b when attached at intervals of the set point X0 in the XYZ rectangular coordinate system which sets a Y-axis as the Z-axis and camera above, and sets the X-axis as a camera longitudinal direction Six mechanical minute gaps of the advancing-side-by-side gaps deltax, delta y, and delta z parallel to each axis of coordinates and the rotation gaps delta a, delta b, and delta c to each axis of coordinates as shown in drawing 10 (b) exist actually. To the criteria image (right image) shown in drawing 11 (b), in the comparison image (left image) shown in drawing 11 (a), these six mechanical gaps turn into three gaps of the advancing-side-by-side gaps alpha and beta and the rotation gap theta, and appear. Moreover, the body image on a criteria image (right image) will differ in magnitude from the body image on a comparison image (right image) from a difference of the field angle by the variation in the focal distance of a lens.
[0006] Although there is comparatively little effect which it has on image-processing information also in the attachment precision of a machining degree about mechanical advancing-side-by-side gap among the gaps in such two images, since the distance of a ranging object can multiply by rotation gap, its effect is large and a limit is in precision reservation by mechanical adjustment. Furthermore, it is difficult to remove the gap by difference of a field angle by mechanical adjustment.
[0007] Moreover, when gap by secular change once arises in the fixed stereoscopic camera, it not only requires a complicated activity, but in the former, it must readjust to a machine structure target and the time amount for readjustment becomes long.
[0008] It aims at this invention having been made in view of the above-mentioned situation, and enabling adjustment of the optical location of a stereoscopic camera to a precision to level with difficult

adjustment mechanically, and offering easily the adjusting device of the stereoscopic camera which can be readjusted also to gap by the secular change after adjustment.

[0009]

[Means for Solving the Problem] Invention according to claim 1 is the adjusting device of a stereoscopic camera which adjusts an optical location of 1 set of stereoscopic cameras, and is characterized by having a means which changes geometrically and makes an optical location of the above-mentioned stereoscopic camera in agreement [adjust and] with a conversion value which set up beforehand an image picturized with the above-mentioned stereoscopic camera according to gap between images equivalent.

[0010] In invention according to claim 1, invention according to claim 2 makes the above-mentioned conversion affine transformation, and is characterized by to compute based on coordinate data which measured and asked for a point of agreement of a corresponding pattern in one pair of images to a pattern for adjustment of a known distance which picturized a conversion value of this affine transformation with the above-mentioned stereoscopic camera, and coordinate data of a point of agreement counted backward from distance information on the above-mentioned pattern for adjustment.

[0011] Invention according to claim 3 is characterized by adjusting an optical location of an optical location of a hand of cut, a horizontal optical location, and a perpendicular direction, and at least 1 of differences of a field angle by variation in a lens focal distance by the above-mentioned conversion in invention according to claim 1 or 2.

[0012] Invention according to claim 4 is characterized by enabling modification of a conversion value of the above-mentioned conversion at any time from a initial value in invention according to claim 1 or 2.

[0013] That is, an image equivalent to an image which carried out alignment optically can be obtained by changing geometrically with a conversion value which set up beforehand an image picturized with a stereoscopic camera to a stereoscopic camera with gap according to gap between images between images.

[0014] In that case, affine transformation performs geometric conversion of an image and a conversion value of affine transformation is computed based on coordinate data which measured and asked for a point of agreement of a corresponding pattern in one pair of images to a pattern for adjustment of a known distance picturized with a stereoscopic camera, and coordinate data of a point of agreement counted backward from distance information on the above-mentioned pattern for adjustment.

[0015] Moreover, by geometric conversion of an image, an optical location of an optical location of a hand of cut, a horizontal optical location, and a perpendicular direction and at least 1 of differences of a field angle by variation in a lens focal distance are adjusted, and modification of a conversion value is enabled at any time from a initial value.

[0016]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing. Drawing 1 - drawing 9 are involved in one gestalt of operation of this invention. Drawing 1 The block diagram of an image compensator, Explanatory drawing in which drawing 2 shows the block diagram of an affine transformation circuit, and drawing 3 shows installation of a CCD camera, Explanatory drawing in which drawing 4 shows the timing of image incorporation and reverse affine transformation, and drawing 5 The flow chart of point-of-agreement measurement processing, Explanatory drawing in which drawing 6 shows an example of the pattern for adjustment, explanatory drawing in which drawing 7 shows distribution of city block distance, explanatory drawing in which drawing 8 shows distribution of the city block distance of the circumference of the minimum point, and drawing 9 are explanatory drawings showing the guess of the minimum point coordinate by straight line approximation.

[0017] In drawing 3 , a sign 1 is the shutter speed adjustable CCD camera which contained image sensors, such as a charge-coupled device (CCD), and this CCD camera 1, and this CCD camera 1 and synchronization are taken, shutter speed adjustable CCD camera 2 is fixed to the both ends of stay 3, and it constitutes the stereo image pick-up system which picturizes the same field from a different view. In addition, drawing 3 (a) is a plan and drawing 3 (b) is front view.

[0018] In this case, although it is mechanically fixed to the above-mentioned stay 3 and the stereo image pick-up system which consists of the two above-mentioned sets of CCD cameras 1 and 2 is constituted so that each lenses 1a and 2a of each CCD cameras 1 and 2 may serve as specification of the same focal distance and may become parallel [a mutual optical axis] It cannot necessarily be told by gap with the image pick-up side of the CCD camera 1 interior, and the image pick-up side of the CCD camera 2 interior etc. that the optical location has gathered strictly to gap of the installation location of each CCD cameras 1 and 2, the variation of a focal distance, and a pan. That is, the error of the rotation gap resulting from mechanical location gap or advancing-side-by-side gap is strictly included in 1 set of images picturized with each CCD cameras 1 and 2, and the field angle changes with variations in the focal distance of a lens.
[0019] For this reason, each CCD cameras 1 and 2 are connected to the image compensator 10, the field angle difference in the image picturized with each CCD cameras 1 and 2, rotation gap, and advancing-side-by-side gap are amended by this image compensator 10, and precision adjustment of the optical location of each CCD cameras 1 and 2 is carried out equivalent. And 1 set of images amended with the above-mentioned image compensator 10 will be read into the stereo image processing system 40, whenever [two image's coincidence] will be estimated by stereo matching, and calculation, image recognition, etc. of an objective three-dimensions location will be performed.
[0020] As shown in drawing 1 , to the above-mentioned image compensator 10 It corresponds to each network of CCD cameras 1 and 2. The analog image from each CCD cameras 1 and 2 The analog interfaces 11 and 12 for doubling with a latter (A/D converters 13 and 14) channel range, A/D converters 13 and 14 which change an analog image into the digital image of predetermined brightness gradation (for example, gray scale of 256 gradation), and the digitized image As opposed to the digital image memorized in the input image memories 15 and 16 memorized temporarily and these input image memories 15 and 16 Geometric conversion of zooming of an image, rotation, a parallel displacement, etc. is performed, and it has the affine transformation circuits 17 and 18 outputted to the stereo image processing system 40.
[0021] An upper left corner is made into a zero for the system of coordinates on an image here to 1 set of images picturized with each CCD cameras 1 and 2. If i axis of coordinates is set as a longitudinal direction and j axis of coordinates is set as a lengthwise direction (refer to drawing 6), to the point of agreement on the comparison image corresponding to the predetermined point on a criteria image The error of the rotation gap resulting from mechanical location gap or advancing-side-by-side gap is included to the case where optical positioning of two sets of CCD cameras 1 and 2 is perfect, and the field angle of a criteria image and the field angle of a comparison image are not necessarily in agreement with the variation in the focal distance of a lens.
[0022] When its attention is paid about two points-of-agreement p' (ip', jp') from which it differs on a comparison image, and q' (iq', jq'), namely, these points-of-agreement p' and q' The original point of agreement p when optical positioning of two sets of CCD cameras 1 and 2 is perfect (ip, jp) q (iq, jq) is considered to move by rotation, advancing side by side, and zooming, and it can be considered that the relation between Point p and point p' and the relation between Point q and point q' are rotation, migration, and the linear transformation, i.e., affine transformation, that zooming compounded.
[0023] Therefore, if it expresses by the homogeneous-coordinates system for which the relation between Point p and point p' and the relation between Point q and point q' used each transformation matrix when alpha and the amount of direction advancing-side-by-side gaps of j were set to beta and the dilation ratio (reduction percentage) was set [the amount of rotation gaps on an i-j plane] to R for theta and the amount of direction advancing-side-by-side gaps of i, it will be given by the following (1) and (2) types.
[0024]

$$\begin{bmatrix} ip' \\ jp' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & \alpha \\ 0 & 1 & \beta \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & 0 & 0 \\ 0 & R & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} ip \\ jp \\ 1 \end{bmatrix} \quad \cdots(1)$$

$$\begin{bmatrix} iq' \\ jq' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & \alpha \\ 0 & 1 & \beta \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} R & 0 & 0 \\ 0 & R & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} iq \\ jq \\ 1 \end{bmatrix} \quad \cdots(2)$$

And the amount theta of rotation gaps, the amount alpha of direction advancing-side-by-side gaps of i, and the amount beta of direction advancing-side-by-side gaps of j are [the simultaneous equations which develop the above (1) and (2) equations and are obtained] computable by the following (7) - (9) formulas with solution Lycium chinense using replacement of the following (3) - (6) equations.

[0025]
deltai =ip-iq -- (3) deltai'=ip' - iq' -- (4) deltaj =jp-jq -- (5) deltaj'=jp' - jq' -- Since it is (6), however p!=q, it is deltai, deltai', deltaj, and deltaj'!=0. Theta=tan -1 {(R-deltai-deltaj' - deltai'-deltaj) /(R-deltai-deltai'+deltaj-deltaj')} -- (7) Alpha=ip'-{R-ip and (R-deltai-deltai'+deltaj-deltaj') -jp- () [R-delta i-delta j'-] deltai'-deltaj}/(R2 and deltai2 +deltaj2) -- (8) beta=jp' - {R-ipand(R-deltai-deltaj' - deltai'-deltaj) +jp- () [R-delta i-delta i'+] deltaj-deltaj'}/(R2 and deltai2 +deltaj2) -- (-- nine --) -- the above -- (-- seven --) - (-- nine --) -- a formula -- it can set -- a point -- p -- ' -- q -- ' -- data -- As shown in drawing 6 , the pattern for adjustment arranged in a known distance (distance which can calculate parallax) is picturized beforehand. It can give as coordinate data of the point of agreement measured from this image pick-up image, and the data of Points p and q can be given as coordinate data of the point of agreement based on the parallax counted backward from a known distance.

[0026] Moreover, it can ask for the dilation ratio R in the above-mentioned (7) - (9) type by the ratio of the distance between two in a criteria image, and the distance between two points of agreement of the comparison image corresponding to these two points. With this gestalt, as shown in drawing 6 , the ratio of the distance between the patterns in a criteria image and the distance between the patterns of a corresponding comparison image is averaged using about five patterns for adjustment, and it asks for a dilation ratio R.

[0027] Details are asked for the distance AC, BC, DC, and EC of the point c of the pattern for adjustment of middle of the screen (ic, jc), and each point a (ia, ja), b (ib, jb), d (id, jd), and e (ie, je) of four patterns for adjustment around a screen by the following (10) - (13) formulas on a criteria image, as shown in drawing 6 . As opposed to each of such distance AC, BC, DC, and EC And point-of-agreement c' of a corresponding distance on a comparison image, i.e., the pattern for adjustment of middle of the screen, (ic', jc'), Each point-of-agreement a' of four patterns for adjustment around a screen (ia', ja'), b -- ' (ib', jb') -- d -- ' (id', jd') -- e -- ' (ie', je') -- distance -- A'C -- ' -- B'C -- ' -- D'C -- ' -- E'C -- ' -- the following -- (-- 14 --) - (-- 17 --) -- a formula -- asking -- (-- 18 --) -- a formula -- being shown -- as -- corresponding -- distance -- a ratio -- averaging -- a dilation ratio R -- asking .

[0028]
AC = {2 (ia-ic)+(ja-jc) 2} 1/2 -- (10) BC = {2 (ib-ic)+(jb-jc) 2} 1/2 -- (11) DC = {2 (id-ic)+(jd-jc) 2} 1/2 -- (12) EC = {2 (ie-ic)+(je-jc) 2} 1/2 -- (13) A'C'={2 (ia' - ic')+(ja' - jc') 2} 1/2 -- (14) B'C'={2 (ib' - ic')+(jb' - jc') 2} 1/2 -- (15) D'C'= -- {-- 2+(jd' - jc') 2 (id' - ic') } 1/2 -- (16) E'C'= [-- more than by (18)] {2 (ie' - ic')+(je' - jc') 2} 1/2 -- (17) R= (A'C'/AC+B'C'/BC+D'C' / DC+E'C' / EC)/5 The dilation ratio R for which it asked, the amount theta of rotation gaps, the amount alpha of direction advancing-side-by-side gaps of i, and the amount beta of direction advancing-side-by-side gaps of j It is given as initial value of the image transformation in the above-mentioned affine transformation circuits 17 and 18, and an image equivalent to having adjusted the optical location of two sets of CCD cameras 1 and 2 can be obtained by carrying out geometrical conversion of the image picturized by two sets of CCD cameras 1 and 2.

[0029] If the above-mentioned affine transformation circuits 17 and 18 are represented with one affine

transformation circuit 17 It is an internal configuration as shown in drawing 2 . The image memory data interface 20 which performs writing of the data to the input image memory 15, and read-out of data, the image memory address interface 21 which performs addressing of the input image memory 15, and the image data from A/D converter 13 The address at the time of reading image data from the input image write-in address-generation circuit 22 which generates the address at the time of writing in the input image memory 15, and the input image memory 15, and performing geometric conversion of an image by reverse affine transformation linear interpolation is performed to the data to generate and in which carried out reverse affine transformation reading appearance, and reading appearance was carried out by the address-generation circuit 23 and reverse affine transformation, and it has the interpolation arithmetic circuit 24 grade which outputs resolution picture data.

[0030] That is, by geometric conversion of the image by the above-mentioned affine transformation circuits 17 and 18, both the subject-copy image before conversion and the image after conversion are digital images which have arranged the pixel on a tetragonal lattice, and the concentration value of the pixel on the image after conversion is given with the concentration value of the correspondence pixel location which carried out reverse affine transformation of the subject-copy image, and asked for it. Since it generally does not become an integer pixel location and a correspondence pixel does not exist in a subject-copy image, the correspondence pixel location of the subject-copy image by this reverse affine transformation performs linear interpolation using the concentration value of 4 pixels of perimeters, and calculates the concentration value of a pixel without a crevice on the image after conversion in the above-mentioned interpolation arithmetic circuit 24.

[0031] In the above-mentioned affine transformation circuits 17 and 18, as shown in drawing 4 , if the sample of the picture signals, such as an NTSC video signal outputted synchronizing with the picture signal, for example, the Horizontal Synchronizing signal from each CCD cameras 1 and 2, and Vertical Synchronizing signal from each CCD cameras 1 and 2, is carried out in the sample period of a field signal, image transformation of this sample image will be carried out in the next field section.

[0032] Namely, according to the channel range of A/D converters 13 and 14, gain offset of the picture signal from each CCD cameras 1 and 2 etc. is adjusted by the analog interfaces 11 and 12. The digital image data A/D conversion was carried out [image data] by A/D converters 13 and 14 It is stored in the input image memories 15 and 16 according to the address generated in the input image write-in address-generation circuits 22 and 22 of the affine transformation circuits 17 and 18. In the next field section Reading appearance of the concentration data of the address generated from the input image memories 15 and 16 in the reverse affine transformation read-out address-generation circuits 23 and 23 of the affine transformation circuits 17 and 18 is carried out.

[0033] And to this concentration data, a interpolation operation is performed in the interpolation arithmetic circuits 24 and 24 of the affine transformation circuits 17 and 18, and an resolution picture is outputted to the stereo image processing system 40. In this case, if the image which picturized the image picturized with CCD camera 2 with the criteria image and CCD camera 1 is used as a comparison image, with this gestalt, the affine transformation circuit 17 by the side of CCD camera 1 (comparison image side) actually performs geometric conversion of an image, and the image from CCD camera 2 by which digital conversion was carried out by A/D converter 14 will be outputted to the stereo image processing system 40 in the affine transformation circuit 18 by the side of CCD camera 2 (criteria image side), without performing geometric conversion.

[0034] The correction value of optical positioning of above-mentioned CCD cameras 1 and 2, i.e., the image transformation value in the above-mentioned affine transformation circuits 17 and 18, is given by the correction value detection equipment 30 shown in drawing 1 . this correction value detection equipment 30 -- a central processing unit (CPU) 31, image memories 32 and 33, and a keyboard 34 -- and It is the computer which consists of CRT display 35 grade. The time of the initial adjustment of the optical location of CCD cameras 1 and 2, When it shifts from the time of initial adjustment according to secular change, it connects with A/D converters 13 and 14 of the above-mentioned image compensator 10 through the above-mentioned image memories 32 and 33. By calculating an image transformation value and initializing the affine transformation circuit 17 of the above-mentioned image compensator 10

(the set point of the affine transformation circuit 18 by the side of a criteria image being fixed with this gestalt, as mentioned above), the adjustment value of the optical location to CCD cameras 1 and 2 can be changed at any time.

[0035] The operation of the image transformation value in the above-mentioned correction value detection equipment 30 picturizes the pattern for adjustment of above-mentioned drawing 6 with CCD cameras 1 and 2, and is performed by measuring the point of agreement of a comparison image to a criteria image from the image pick-up image of this pattern for adjustment. Hereafter, the point-of-agreement measurement processing in the above-mentioned correction value detection equipment 30 is explained according to the flow chart of drawing 5 .

[0036] With the above-mentioned correction value detection equipment 30, if the program of point-of-agreement measurement processing of drawing 5 starts, image data will be read from the input image memories 15 and 16 of the image compensator 10, and it will display on CRT display 35, and will become the directions input of the field which uses as a reference pattern the pattern for adjustment reflected in the criteria image at step S101. And if the directions input of a reference pattern field is performed from input devices, such as a keyboard 34 or a mouse which is not illustrated, it will progress to step S102.

[0037] At step S102, it becomes the directions input of the seek area of the comparison pattern of the comparison image corresponding to the reference pattern of a criteria image, and similarly, if the directions input of a comparison pattern seek area is performed from input devices, such as a keyboard 34 or a mouse which is not illustrated, and it progresses to step S103, it will cross throughout the directed seek area, the comparison pattern of the same magnitude as a reference pattern will be cut down, and the mutual city block distance D will be calculated. If the city block distance D acquired at this step S103 has become matrix-like and it writes D [the i line j train element of the city block distance D] [i, j], distribution of the city block distance D will turn into distribution as shown in drawing 7 .

[0038] Henceforth [continuing step S104], the point of agreement of the pattern of a criteria image and a comparison image is calculated. Although this point of agreement is given with the coordinate (imin, jmin) of the point, i.e., the point that correlation is the strongest, that the element of the city block distance D serves as the minimum, this coordinate (imin, jmin) is the discrete value calculated for every pixel, and wants precision for using for measurement by 1 pixel or less. Therefore, the above-mentioned coordinate (imin, jmin) is made into a temporary point of agreement, and it asks for a point of agreement (isub, jsub) with a resolution of 1 pixel or less by the following processings.

[0039] that is, it becomes a value which is continuously distributed in a symmetry form in the circumference of the minimum point as a dashed line shows the city block distance D, when it is assumed that a pixel is small to infinity although considering the minimum point of the direction of i the city block distance D of the minimum point circumference (imin line circumference) of a jmin train is shown by the round mark of drawing 8 and which can be rich, can make and is different from a point of agreement with temporary i coordinate of the minimal value of a dashed line. The same is said of the direction of j.

[0040] For this reason, henceforth [step S104], distribution of the city block distance D uses becoming a symmetry form, pinpoints the location of the minimal value in the circumference of the minimum point from the size relation of the difference of the city block distance D before and behind a temporary point of agreement, and calculates the coordinate of a point of agreement by straight line approximation. In addition, although the processing which searches for the i coordinate isub of a point of agreement is explained, the j coordinate jsub of a point of agreement can be searched for similarly here.

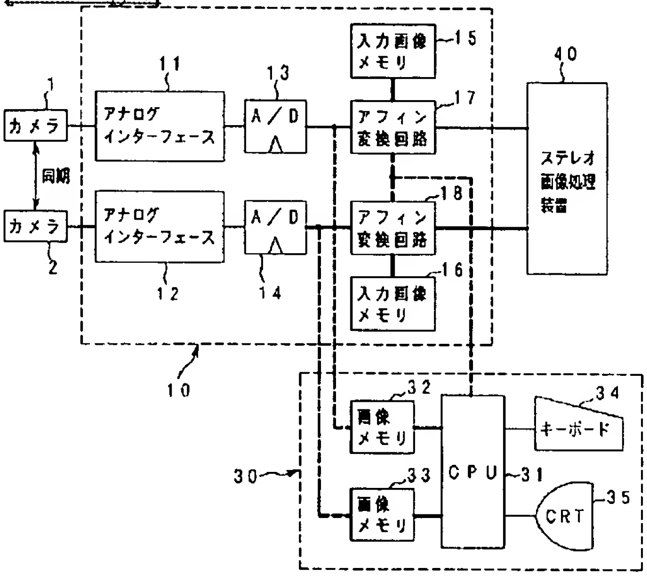
[0041] When the differences delta D0 and delta D1 of the city block distance D before and behind the i coordinate imin of a temporary point of agreement are searched for by the following (19) and (20) types at step S104, namely, at step S105 Change of the city block distance D which applies them to Coordinate imin from coordinate imin-1 by comparing mutually, In consideration of change of the city block distance D applied to coordinate imin+1 and distribution of the city block distance D being symmetrical with the circumference of the minimum point, the minimum point centers on Coordinate

imin from Coordinate imin. It investigates in any between coordinate imin-1, and between Coordinates imin, Coordinate imin and coordinate imin+1 it exists.
[0042]
deltaD0=D[imin-1, jmin]-D [imin, jmin] -- (19) deltaD1=D[imin+1, jmin]-D [imin, jmin] -- At the time of (20), consequently deltaD0<deltaD1 namely, when the last twist of Coordinate imin is also large in the direction of the back and the city block distance D changes, around coordinate imin (temporary point of agreement) Judge that i coordinate of the minimum point is between Coordinate imin and coordinate imin-1, and it progresses to step S106 from the above-mentioned step S105. If inclination m of the straight line L1 which passes along Point D [imin, jmin] and Point D [imin+1, jmin] is computed, the straight line L2 which inclines and is set to -m in Point D [imin-1, jmin] at step S107 will be computed, and it will progress to step S110.
[0043] On the other hand, at the above-mentioned step S105, at the time of deltaD0 >=deltaD1, i.e., the coordinate imin (temporary point of agreement) circumference When the back twist of Coordinate imin is [ahead] also large and the city block distance D changes Judge that i coordinate of the minimum point is between Coordinate imin and coordinate imin+1, and it progresses to step S108 from the above-mentioned step S105. If inclination m of the straight line L1 which passes along Point D [imin, jmin] and Point D [imin-1, jmin] is computed, the straight line L2 which inclines and is set to -m in Point D [imin+1, jmin] at step S109 will be computed, and it will progress to step S110.
[0044] At step S110, the intersection of straight lines L1 and L2 is calculated, and a program is ended for this intersection as an i coordinate isub of the minimum point. Drawing 9 shows the straight lines L1 and L2 at the time of deltaD0 >=deltaD1, approximates distribution of the city block distance D of the circumference of the minimum point in the straight line which intersects perpendicularly mutually, and can search for the minimum point by asking for the intersection of each straight line. And it can ask for where [of a seek area] the reference pattern is reflected with the resolution of 1 pixel or less by computing the point-of-agreement coordinate jsub of the direction of j similarly.
[0045] After repeating the above processing, asking for the point of agreement of each pattern for adjustment and computing a dilation ratio R by the above-mentioned (18) types, by the above-mentioned (7) - (9) type, the amount theta of rotation gaps, the amount alpha of direction advancing-side-by-side gaps of i, and the amount beta of direction advancing-side-by-side gaps of j are computed, and it gives as initial value to the affine transformation circuit 17 of the image compensator 10.
[0046] Without this requiring complicated mechanical adjustment, the image with which the optical location of a stereoscopic camera was doubled equivalent can be obtained easily, moreover, by adjustment of a mechanical installation location, a difference of a difficult field angle can also be canceled and the processing precision of an image processing can be raised. Moreover, when gap arises in the optical location of a stereoscopic camera according to secular change, it can readjust easily.
[0047]
[Effect of the Invention] As explained above, the effect which was [readjust / it / easily] excellent according to this invention, without could adjust the optical location of a stereoscopic camera to the precision to level with difficult adjustment mechanically, and requiring a complicated activity also to gap by the secular change after adjustment is acquired.

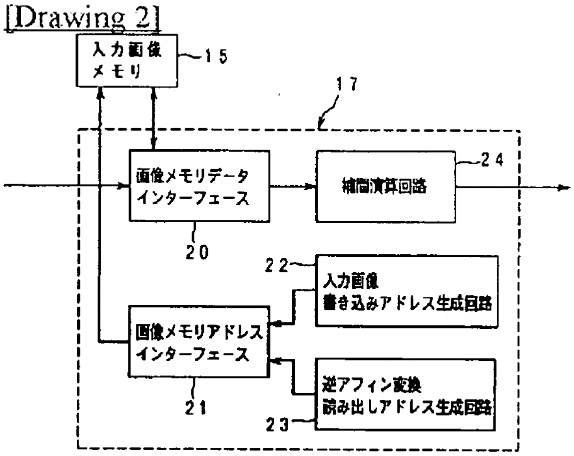
[Translation done.]

DRAWINGS

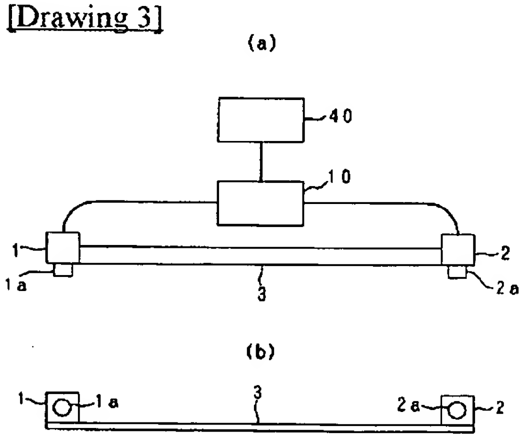
[Drawing 1]



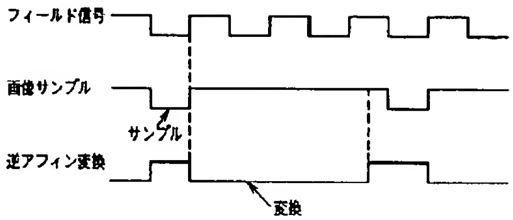
[Drawing 2]



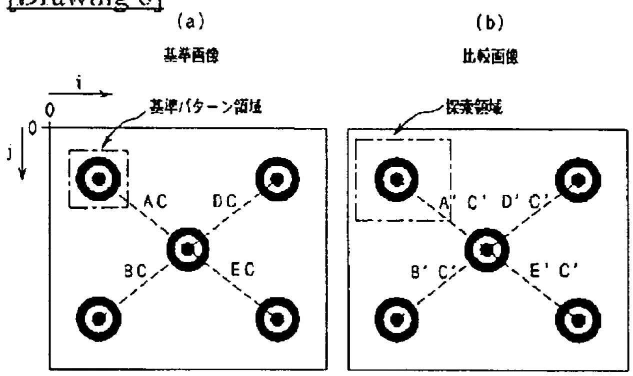
[Drawing 3]



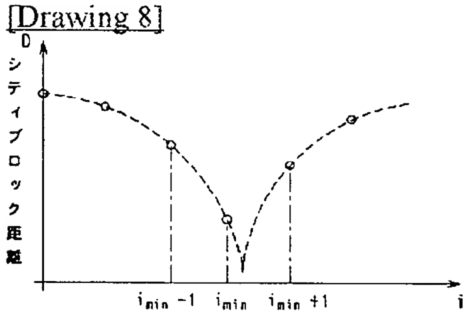
[Drawing 4]



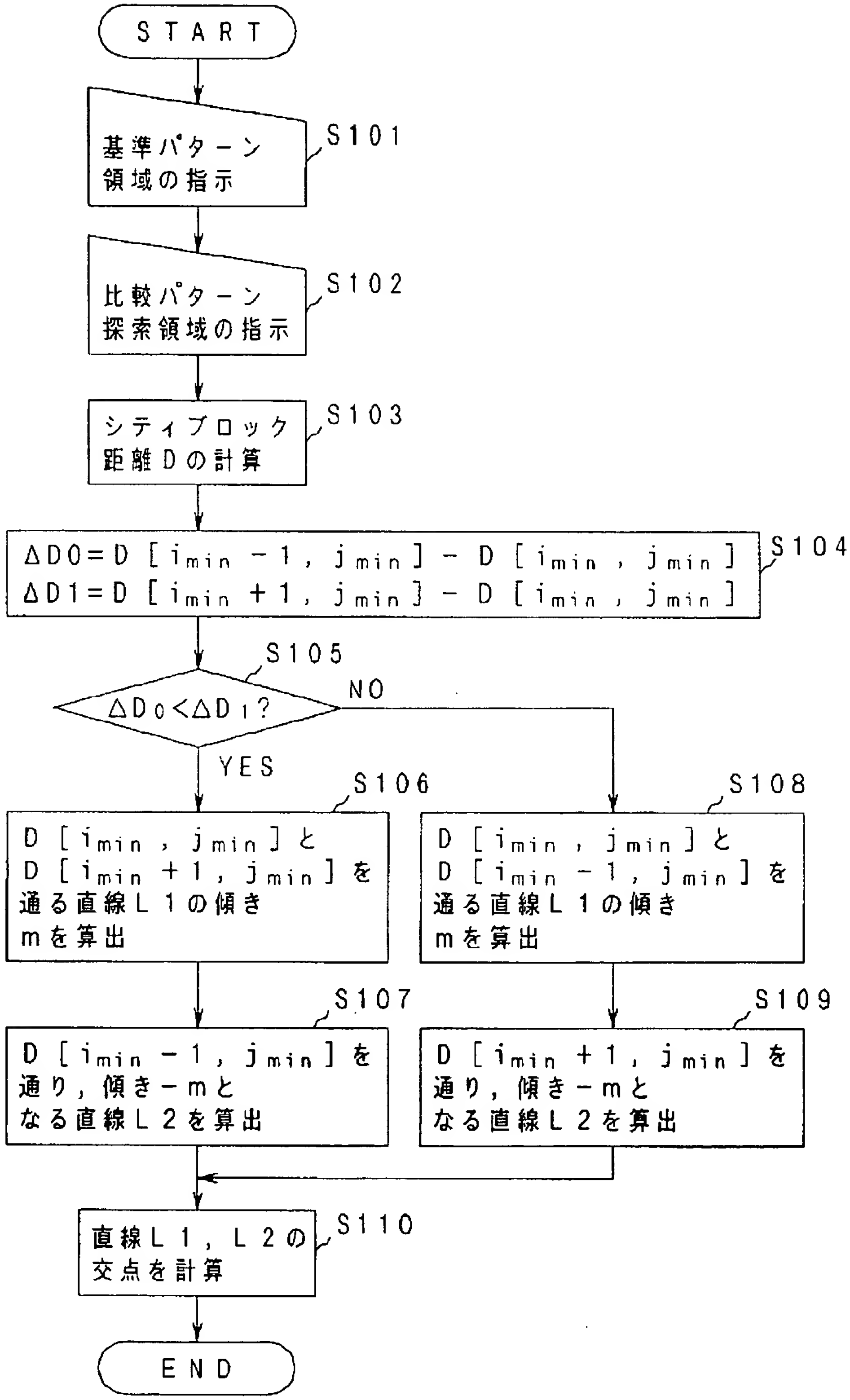
[Drawing 6]



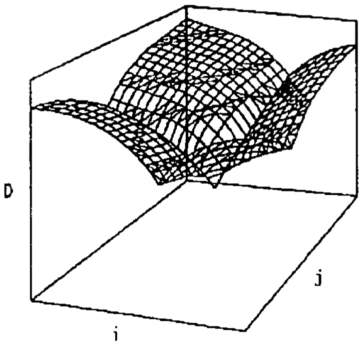
[Drawing 8]



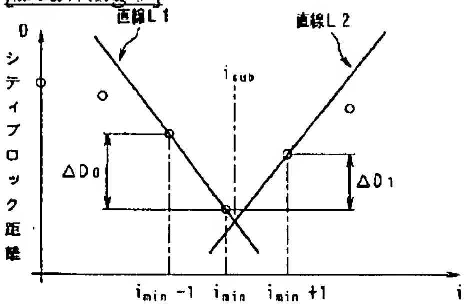
[Drawing 5]


START
基準パターン領域の指示
S101
比較パターン探索領域の指示
S102
シティブロック距離Dの計算
S103
ΔD0=D[i_{min}−1, j_{min}]−D[i_{min}, j_{min}]
ΔD1=D[i_{min}+1, j_{min}]−D[i_{min}, j_{min}]
S104
S105
$\Delta D_0 < \Delta D_1$?
NO
YES
S106
D[i_{min}, j_{min}]とD[i_{min}+1, j_{min}]を通る直線L1の傾きmを算出
S108
D[i_{min}, j_{min}]とD[i_{min}−1, j_{min}]を通る直線L1の傾きmを算出
S107
D[i_{min}−1, j_{min}]を通り，傾き−mとなる直線L2を算出
S109
D[i_{min}+1, j_{min}]を通り，傾き−mとなる直線L2を算出
直線L1，L2の交点を計算
S110
END

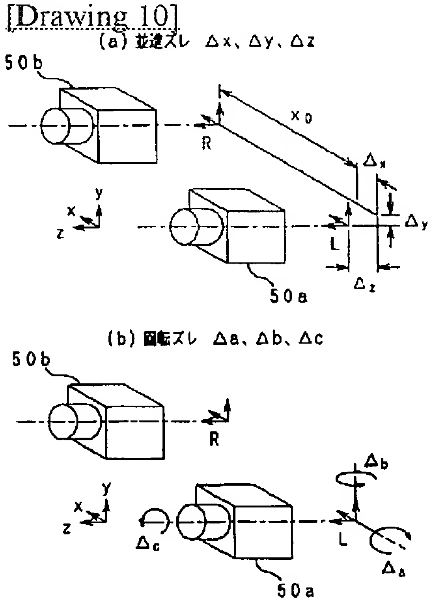
[Drawing 7]



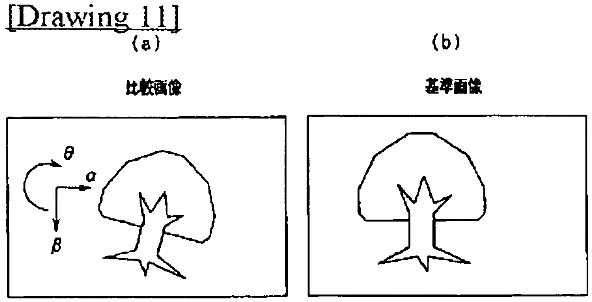
[Drawing 9]



[Drawing 10]



[Drawing 11]



[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is involved in one gestalt of operation of this invention, and is the block diagram of an image compensator.
[Drawing 2] The block diagram of the same as the above and an affine transformation circuit
[Drawing 3] The same as the above, explanatory drawing showing installation of a CCD camera
[Drawing 4] Explanatory drawing showing the timing of the same as the above, image incorporation, and reverse affine transformation
[Drawing 5] The flow chart of the same as the above and point-of-agreement measurement processing
[Drawing 6] Explanatory drawing showing an example of the same as the above and the pattern for adjustment
[Drawing 7] Explanatory drawing showing distribution of the same as the above and city block distance
[Drawing 8] Explanatory drawing showing distribution of the city block distance of the circumference of the same as the above and the minimum point
[Drawing 9] Explanatory drawing showing the guess of the minimum point coordinate by the same as the above and straight line approximation
[Drawing 10] Explanatory drawing showing mechanical location gap of a stereoscopic camera
[Drawing 11] Explanatory drawing showing the image gap in two images picturized with the stereoscopic camera
[Description of Notations]
1 Two -- CCD camera
10 -- Image Compensator
17 18 -- Affine transformation circuit
30 -- Correction Value Detection Equipment
isub, jsub -- Point-of-agreement coordinate
theta -- The amount of rotation gaps
alpha, beta -- The amount of advancing-side-by-side gaps
R -- Dilation ratio

[Translation done.]